WE CLAIM:

1. A method of monitoring performance of an optical communications system, the method comprising, for at least one channel of the optical communications system, steps of:

   sampling the channel signal at a predetermined sample rate at least equal to a baud rate of the channel to generate sequential N-bit samples (where N>1) respectively indicative of a detected analog value of the channel signal;

   storing sample data corresponding to a set of N-bit samples generated within a predetermined time interval; and

   calculating at least one performance parameter of the optical communications system based on the sample data.

2. A method as claimed in claim 1, wherein the step of sampling the channel signal comprises a step of sampling a complex E-field of the channel signal.

3. A method as claimed in claim 2, wherein the step of sampling the complex E-field of the channel signal comprises a step of sampling at least two orthogonal components of the channel signal.

4. A method as claimed in claim 3, wherein the orthogonal components comprise any one or more of:

   Cartesian signal components; and

   polar signal components.

5. A method as claimed in claim 3, wherein respective orthogonal components of each polarization mode of the channel signal are independently sampled.

6. A method as claimed in claim 1, wherein the sample data comprises any one of:

   the set of sequential N-bit samples generated within the predetermined time interval;

   a corresponding set of filtered sample values derived from the set of N-bit samples generated within the predetermined time interval; and

   one or more symbol values derived from the set of filtered sample values.

7. A method as claimed in claim 1, wherein the predetermined time interval corresponds with any one of:

   a selected number of symbols conveyed by the channel signal;

   a selected number of sequential N-bit samples; and

   a selected number of bits of the recovered data stream.

8. A method as claimed in claim 6, wherein respective sample data of at least two channel signals is stored during respective time intervals which at least partially overlap in time.

9. A method as claimed in claim 8, wherein the respective time intervals are substantially simultaneous.

10. A method as claimed in claim 8, wherein the step of calculating at least one performance parameter comprises steps of:

identifying a period during which the respective time intervals overlap; and

correlating respective sample data of each channel stored during the identified overlap period.

11. A method as claimed in claim 1, further comprising steps of:

processing the samples to derive a recovered data stream corresponding to subscriber data encoded within the channel signal; and

storing a plurality of bits of the recovered data stream corresponding to the stored sample data.

12. A method as claimed in claim 11, further comprising a step of compensating a delay between generation of a sample and generation of a corresponding bit of the recovered data stream.

13. A method as claimed in claim 12, wherein the step of calculating at least one performance parameter comprises a step of correlating each stored bit of the recovered data stream with the stored sample data used to generate the stored bit.

14. A method as claimed in claim 13, further comprising steps of:

identifying errored symbols within the channel signal; and

processing the respective sample data to identify signal impairments associated with the errored symbols.

15. A method as claimed in claim 1, further comprising a step of controlling the sample rate such that the sample data satisfies Nyquist's theorem.

16. A method as claimed in claim 15, wherein the step of calculating at least one performance parameter comprises a step of reconstructing a portion of the channel signal sampled during the predetermined time interval, based on the sample data.

17. A method as claimed in claim 16, further comprising a step of correlating first and second reconstructed portions of the channel signal received during respective first and second time intervals.

18. A method as claimed in claim 1, further comprising a step of selecting a polarization mode of the channel signal, such that the stored sample data corresponds with a set of sequential N-bit samples of the selected polarization mode.

19. A method as claimed in claim 18, wherein the step of calculating at least one performance parameter comprises steps of:

calculating a respective performance parameter value for each polarization mode; and

comparing the calculated performance parameter values.

20. A method as claimed in claim 1, further comprising steps of:

tapping a link of the optical communications system at two or more locations to obtain respective tap signals including the channel signal; and

selecting one of the tapped signals, such that the stored sample data corresponds with a set of sequential N-bit samples of the selected tap signal.

21. A method as claimed in claim 20, wherein the step of calculating at least one performance parameter comprises steps of:

calculating a respective performance parameter value for each tap signal; and

comparing the calculated performance parameter values.

22. A digital performance monitoring system for an optical communications system, the system comprising, for at least one channel signal of the optical communications system:

a respective data path for processing the channel signal, the data path comprising:

an Analog-to-digital A/D converter for sampling the channel signal at a predetermined sample rate at least equal to a baud rate of the channel to generate sequential N-bit samples (where N>1) respectively indicative of a detected analog value of the channel signal;

a respective channel monitor for monitoring the data path, the channel monitor comprising:

a sample memory for storing sample data corresponding to a set of N-bit samples generated by the A/D converter within a predetermined time interval; and

a processor for calculating at least one performance parameter of the optical communications system based on at least the stored sample data.

23. A system as claimed in claim 22, wherein the sample data comprises any one of:

the set of sequential N-bit samples generated within the predetermined time interval;

a corresponding set of filtered sample values derived from the set of N-bit samples generated within the predetermined time interval; and

one or more symbol values derived from the set of filtered sample values.

24. A system as claimed in claim 22, wherein the predetermined time interval corresponds with any one of:

a selected number of symbols conveyed by the channel signal;

a selected number of samples generated by the A/D converter; and

a selected number of bits of the recovered data stream generated by the data decoder.

25. A system as claimed in claim 24, wherein sample data of at least two channel signals is stored during respective time intervals which at least partially overlap in time.

26. A system as claimed in claim 25, wherein the respective time intervals are substantially simultaneous.

27. A system as claimed in claim 22, wherein:

the data path further comprises a data decoder for processing the samples to derive a recovered data stream corresponding to subscriber data encoded within the channel signal; and

the channel monitor further comprises a data memory for storing a plurality of bits of the recovered data stream corresponding to the stored sample data.

28. A system as claimed in claim 27, further comprising a controller adapted to compensate a delay between generation of the sample data and generation of a corresponding bit of the recovered data stream by the decoder, whereby each stored bit of the recovered data stream is correlated with the sample data used to generate the stored bit.

29. A system as claimed in claim 22, further comprising a data bus adapted to simultaneously convey a "write" signal from the processor to each one of a plurality of parallel channel monitors, such that respective sample data is stored by each of the channel monitors

within respective time intervals that at least partially overlap in time.

30. A system as claimed in claim 22, further comprising a mode selector for selecting a polarization mode of the channel signal, the mode selector beoing coupled to an input of the A/D converter such that the sample data stored in the sample memory corresponds with a set of sequential N-bit samples of the selected polarization mode.

31. A system as claimed in claim 22, further comprising:

two or more optical couplers for tapping a link of the optical communications system at respective locations, to obtain respective tap signals; and

a tap selector for selecting one of the tap signals, such that the stored sample data corresponds with a set of sequential N-bit samples of the selected tap signal.

32. A system as claimed in claim 22, further comprising a coherent optical receiver for selectively detecting the channel signal within a wavelength division multiplexed (WDM optical signal.

33. A system as claimed in claim 32, wherein the processor is operative to generate a tuning signal for controlling a local oscillator of the coherent optical receiver to select a frequency of the channel signal detected by the coherent optical receiver.

34. A method of monitoring performance of an optical communications system , the method comprising, for at

least one channel of the optical communications system, steps of:

sampling a complex E-field of the channel signal to generate sequential N-bit samples (where $N \geq 1$) respectively indicative of a detected complex value of the channel signal;

storing sample data corresponding to a set of N-bit samples generated within a predetermined time interval; and

calculating at least one performance parameter of the optical communications system based on the sample data.

35. A method as claimed in claim 34, wherein the step of sampling the complex E-field of the channel signal comprises steps of:

sampling at least two orthogonal components of the channel signal; and

generating respective sequential N-bit sample values for each sampled orthogonal component.

36. A method as claimed in claim 35, wherein the orthogonal components comprise any one or more of:

Cartesian signal components; and

polar signal components.

37. A method as claimed in claim 35, wherein respective orthogonal components of each polarization mode of the channel signal are independently sampled.

38. A method as claimed in claim 34, wherein the sample data comprises any one of:

the set of sequential N-bit samples generated within the predetermined time interval;

a corresponding set of filtered sample values derived from the set of N-bit samples generated within the predetermined time interval; and

one or more symbol values derived from the set of filtered sample values.

39. A method as claimed in claim 34, wherein the predetermined time interval corresponds with any one of:

a selected number of symbols conveyed by the channel signal;

a selected number of sequential N-bit samples; and

a selected number of bits of the recovered data stream.

40. A digital performance monitoring system for an optical communications system, the system comprising, for at least one channel signal of the optical communications system:

an Analog-to-digital A/D converter for sampling the a complex E-field of the channel signal at a predetermined sample rate to generate sequential N-bit samples (where N>1) respectively indicative of a detected complex value of the channel signal;

a sample memory for storing sample data corresponding to a set of N-bit samples generated by the A/D converter within a predetermined time interval; and

a processor for calculating at least one performance parameter of the optical communications system based on at least the stored sample data.

41. A system as claimed in claim 40, wherein the A/D converter comprises a respective A/D converter for sampling each one of at least two orthogonal components of the channel signal, each A/D converter being operative to generate sequential N-bit sample values for its respective orthogonal component.

42. A system as claimed in claim 41, wherein the orthogonal components comprise any one or more of:

Cartesian signal components; and

polar signal components.

43. A system as claimed in claim 40, wherein the sample data comprises any one of:

the set of sequential N-bit samples generated within the predetermined time interval;

a corresponding set of filtered sample values derived from the set of N-bit samples generated within the predetermined time interval; and

one or more symbol values derived from the set of filtered sample values.

44. A system as claimed in claim 40, wherein the predetermined time interval corresponds with any one of:

a selected number of symbols conveyed by the channel signal;

a selected number of samples generated by the A/D converter; and

a selected number of bits of the recovered data stream generated by the data decoder.